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Biomaterials reaction to fire

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There is a strong demand for alternative sustainable construction materials. The drivers are to apply materials that provide "natural" surfaces, facades and structures. Further, materials with high insulation at low costs and materials improving a healthy indoor climate are of high interest. Therefore, new bio-composite materials are developed to reach these technical and commercial targets. The materials need to fulfill a number of parameters in order to be acceptable on the market as well as being reusable within the philosophy of a circular economy. They need to have a minimum of VOC emissions, good physical mechanical properties and last not least an acceptable classification form the fire safety engineering perspective. In conclusion, the bio-composites are regarded as sustainable materials, but have to regard fire safety requirements to be widely acceptable in construction of sustainable, residential buildings.

In order to fulfill the latter requirements several means are applicable, such as sprinkling and /or passive fire protection systems. Additional, fire resistance of building materials may be improved using flame retardants as boron salts, aluminum hydroxide or ammonium phosphate. These may have adverse effects to the indoor climate or the environment as the salts may be washed out with time, resulting in potential adverse effects to people as well as a decrease in the ability to protect against ignition.

Alternative flame retardant systems for bio-composites are therefore needed. This paper describes how the properties of biomaterials may be improved and may lead to a sustainable fire protection. This is shown in figure 1, on the basis of an investigation of pressed wooden plates. The wood is first separated in the three main components cellulose fibers, hemicellulose and lignin. This allows engineering new bio-composites with containing more of the more flame retardant components, as e.g. lignin. Some first results are shown and the wider perspective of this approach is described.

Figure 1

Lit.: Markert, Shaukat, Hastrup, Residential fire solutions in the building sector, presentation on the Nordic Fire Safety Days 2017 , Ålborg University, august 2017
Xing et al. (2013) Functionalized lignin for halogen free flame retardant rigid polyurethane foam: Preparation, thermal stability, fire performance and mechanical properties; Journal of Polymer Research 20(9) pp. 1-12